PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.:	10/828,420
Filing Date:	April 20, 2004
Applicant:	Scott Dewey et al.
Group Art Unit:	2829
Examiner:	Ernest F. Karlsen
Title:	HIGH VOLTAGE ISOLATION DETECTION OF A FUEL CELL SYSTEM USING MAGNETIC FIELD CANCELLATION
Attorney Docket:	GP-303953

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APPELLANT'S APPEAL BRIEF

This is Appellant's Second Appeal Brief filed in accordance with 37 CFR § 41.37 appealing the Examiner's Office Action mailed March 4, 2008 that reopened prosecution. Appellant's original Appeal Brief was filed on January 21, 2008 appealing the Examiner's Final Office Action mailed August 23, 2007. A second Notice of Appeal is being submitted concurrently herewith.

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I. Real Party in Interest

The real party in interest for this appeal is the General Motors Corporation of Detroit, Michigan, the assignee of this application.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of the Claims

Claims 1-19 are pending. Claims 1-19 stand rejected. Claims 1-19 are on appeal. No claim has been cancelled. No claim has been allowed. No claim has been objected to.

IV. Status of Amendments

No amendments have been made.

V. Summary of Claimed Subject Matter

Claims 1 and 10 claim a fuel cell system and claim 15 claims a method for detecting a fault condition in a fuel cell system, such as fuel cell system 60 shown in figure 4, page 5, line 15, paragraph [0019]. The fuel cell system 60 includes a fuel cell stack 62 having a positive stack terminal 64 and a negative stack terminal 66, claims 1, 10 and 15, page 5, lines 18 and 19, paragraph [0019]. The positive terminal 64 is electrically coupled to a high voltage component 68 by an electrical conductor 70 and the negative terminal 66 is electrically coupled to the high voltage component 68 by an electrical conductor 72, claims 1, 10 and 15, page 5, lines 19-22, paragraph [0019]. The conductors 70 and 72 extend through an opening 34 in a magnetic field concentrator, such as torroid 32, claims 1, 10 and 15, page 5, lines 24 and 25, paragraph [0019]. A

sensor 42 is positioned within an opening in the magnetic field concentrator 32, and is electrically coupled to a current source 44, claims 1, 10 and 15, page 4, line 30 - page 5, line 1, paragraph [0017].

During normal stack operation, the current flowing through the conductors 70 and 72 is the same and in opposite directions so that the magnetic fields generated by the current flows through the conductors 70 and 72 cancel and the output of the amplifier 46 would be zero, page 5, lines 25-30. If the high voltage isolation of the system 60 fails where the high voltage component 68 becomes electrically coupled to ground, some of the current exiting the fuel cell stack 62 on the conductor 72 will not be returned to the fuel cell stack 62 on the conductor 70, and will be directed to ground, page 5, line 31 - page 6, line 2. Thus, the current propagating through the conductors 70 and 72 will be different depending on the magnitude of the isolation fault, and the magnetic fields will not completely cancel. The magnetic field difference between the magnetic fields generated by the conductors 70 and 72 will be detected by the sensor 42 that provides the signal to the amplifier 46, page 6, lines 4-9. A signal from the amplifier 46 is received by a controller 76 which will take the appropriate action, such as shutting down the fuel cell system, claims 1, 10 and 15, page 5, line 31 - page 6, line 15.

VI. Grounds of Rejection to be Reviewed on Appeal

Whether claims 1-19 should be rejected under 35 USC § 103(a) as being unpatentable over U.S. Patent Number 3,621,334 issued to Burns et al. (hereinafter Burns) in view of U.S. Patent No. 7,079,406 issued to Kurokami et al. (hereinafter Kurokami).

VII. Argument

A. Claims 1-19 are not obvious in view of Burns and Kurokami

1. Independent claims 1, 10 and 15

Independent claims 1, 10 and 15 each include a high voltage component, a fuel cell stack including a positive terminal and a negative terminal, a first conductor electrically coupled to the positive terminal and the high voltage component, a second conductor electrically coupled to the negative terminal and the high voltage component, where a current propagating through the first and second conductors is in opposite directions, a magnetic field concentrator including an opening where the first and second conductors extend through the opening and where the first and second conductors generate magnetic fields that are concentrated by the magnetic field concentrator, and a magnetic sensor positioned in the magnetic field concentrator that detects the magnetic field, where the sensor provides a difference signal representative of the difference between the current propagating through the first and second conductors.

2. Discussion of Burns

Burns discloses a ground fault sensing circuit that includes input terminals 10 and 12 connected to an AC or DC power source. The ground fault sensing circuit also includes a core 30 having a primary winding 26 coupled to the terminal 10 and wound around one leg of the core 30, and a secondary primary winding 28 coupled to the input terminal 12 and wound around another leg of the core 30. An air gap is defined in the core 30 and a Hall effect device 32 is placed in the air gap. A power supply 34 provides power to the Hall effect device 32. The windings 26 and 28 are also coupled to output terminals 14 and 16 that are connected to a load 70. If current traveling through the

coils 26 and 28 are the same, no magnetic flux is produced in the core 30. However, if ground leakage occurs in the circuit, current propagating through the coils 26 and 28 will not be equal, which will be detected by the Hall effect sensor 32 and which will cause a circuit breaker 24 to be tripped disconnecting the load 70. Burns does not say anything about the AC or DC power source being a fuel cell stack or the load 70 being a high voltage load.

3. Discussion of Kurokami

Kurokami discloses an inverter 2 coupled between a DC power supply 1, particularly a solar battery, and a grounded system 3. The inverter 2 includes a control circuit 11 including a ground fault detector 13. A current detector 12 detects a differential current between the positive line and the negative line of the solar battery 1, and if that differential current is great enough, the ground fault detector 13 opens a switch 18 to provide ground fault isolation. Kurokami does not say anything about the ground fault detector 13 using magnetic field cancellation to detect the ground fault.

4. Discussion

Appellant acknowledges that fault isolation detection systems are known to be used in fuel cell systems for safety purposes, as discussed in paragraphs [0007] and [0008] of the specification. However, in order to address some of the drawbacks with the fault isolation detection systems used in the art for fuel cell systems, Appellant's invention employs magnetic field cancellation for the fault detection, as claimed. Appellant respectfully submits that the Examiner has not established a *prima facie* case of obviousness by the combination of Burns and Kurokami because there is no teaching in these references of detecting isolation fault failures in a fuel cell system using

magnetic field cancelling. Particularly, there is no nexus for using magnetic field cancelling to detect a current flow difference for a current flowing to a fuel cell stack and a current flowing from a fuel cell stack. Appellant submits that the prior art does not teach providing two wires extending through a magnetic field concentrator, where the wires are electrically coupled to a fuel cell stack and a high voltage component. Kurokami does not teach detecting leakage currents by magnetic field cancellation and Burns only teaches detecting fault currents using magnetic field cancellation without being specific to the system generating the fault. Therefore, Appellant submits that the §103(a) rejection should be withdrawn.

VIII. Conclusion

As discussed above, Appellant respectfully submits that the Examiner has not established a *prima facie* case of obviousness by the combination of Burns and Kurokami. It is therefore respectfully requested that the §103(a) rejection be reversed.

Respectfully submitted,

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CLAIMS APPENDIX

COPY OF CLAIMS INVOLVED IN THE APPEAL

1. A fuel cell system comprising:

a high voltage component;

a fuel cell stack including a positive terminal and a negative terminal;

a first conductor electrically coupled to the positive terminal and the high voltage component;

a second conductor electrically coupled to the negative terminal and the high voltage component, wherein a current propagating through the first and second conductors is in opposite directions;

a magnetic field concentrator including an opening, said first and second conductors extending through the opening, wherein a current propagating through the first and second conductors generate magnetic fields that are concentrated by the magnetic field concentrator; and

a magnetic sensor positioned relative to the magnetic field concentrator, said sensor detecting the magnetic field in the magnetic field concentrator and providing a difference signal representative of the difference between the current propagating through the first conductor and the current propagating through the second conductor.

2. The system according to claim 1 further comprising an amplifier, said amplifier being responsive to the difference signal from the sensor and providing an amplified output signal indicative of the difference between the current propagating through the first conductor and the current propagating through the second conductor.

3. The system according to claim 1 wherein the sensor is a Hall effect sensor.

4. The system according to claim 3 further comprising a current source, said current source providing a current to the sensor.

5. The system according to claim 1 wherein the magnetic field concentrator is a torroid.

6. The system according to claim 5 wherein the sensor is positioned within the torroid.

7. The system according to claim 5 wherein the torroid is a ferrite torroid.

8. The system according to claim 1 wherein the high voltage component is a vehicle component.

9. The system according to claim 8 wherein the difference signal generated by the sensor represents a fault detection of an electrical isolation system.

10. A fuel cell system comprising:

a high voltage component;

a fuel cell stack including a positive terminal and a negative terminal;

a first conductor electrically coupled to the positive terminal and the high voltage component;

a second conductor electrically coupled to the negative terminal and the high voltage component, wherein a current propagating through the first and second conductors is in opposite directions and generate magnetic fields; and

a magnetic sensor positioned relative to the first and second conductors, said sensor detecting a combined magnetic field and providing a difference signal representative of the difference between the current propagating through the first conductor and the current propagating through the second conductor, wherein the difference signal generated by the sensor represents a fault detection of an electrical isolation system.

11. The system according to claim 10 further comprising a torroid including an opening, said first and second conductors extending through the opening, said sensor being positioned within the torroid.

12. The system according to claim 10 further comprising an amplifier, said amplifier being responsive to the difference signal from the sensor and providing an amplified output signal indicative of the difference between the current propagating through the first conductor and the current propagating through the second conductor.

13. The system according to claim 10 wherein the sensor is a Hall effect sensor.

14. The system according to claim 10 wherein the high voltage component is a vehicle component.

15. A method of detecting a fault condition of an isolation system in a fuel cell system, said method comprising:

providing a high voltage component;

providing a fuel cell stack including a positive terminal and a negative terminal;

electrically coupling a first conductor to the positive terminal and the high voltage component;

electrically coupling a second conductor to the negative terminal and the high voltage component, wherein a current propagating through the first and second conductors is in opposite directions and generate magnetic fields;

detecting the magnetic fields generated by the first and second conductors; and

providing a signal representative of the difference between the current propagating through the first conductor and the current propagating through the second conductor from the detected magnetic field.

16. The method according to claim 15 wherein detecting the magnetic fields generated by the first and second conductors includes detecting the magnetic fields generated by the first and second conductors by a magnetic sensor.

17. The method according to claim 16 wherein detecting the magnetic fields generated by the first and second conductors includes detecting the magnetic fields generated by the first and second conductors by a magnetic sensor positioned within a torroid, wherein the first and second conductors extend through an opening in the torroid.

18. The method according to claim 15 wherein detecting the magnetic fields generated by the first and second conductors includes detecting the magnetic fields generated by the first and second conductors by a Hall effect sensor positioned within a torroid, wherein the first and second conductors extend through an opening in the torroid.

19. The method according to claim 15 wherein the high voltage component is a vehicle component.

EVIDENCE APPENDIX

There is no evidence pursuant to §1.130, §1.131 or §1.132.

RELATED PROCEEDINGS APPENDIX

There are no decisions rendered by a court or the Board in any proceeding identified in Section II of this Appeal Brief.